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BY L. WALLACE

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A Collection of the Band-Head Wavelengths of N_2 and N_2^+

BY L. WALLACE

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A COLLECTION OF THE BAND-HEAD WAVELENGTHS OF N_2 AND N_2^+*

L. WALLACE

Yerkes Observatory, University of Chicago, Williams Bay, Wisconsin

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ABSTRACT

The wavelengths of the band heads of N_2 and N_2^+, extending from the vacuum ultraviolet into the far infrared, are tabulated according to the electronic transition involved. Supplementary material is provided to facilitate problems of identification.

This summary includes all the band-head wavelengths of gaseous N_2 and N_2^+ found in the literature, limited only by the requirement that the observations have been fitted into the energy-level schemes of N_2 or N_2^+ or have been arranged in Delandres schemes and are generally accepted as being due to N_2. Into the latter category fall the green bands, Herman's infrared bands, and the Hepner-Herman bands. While I am aware that such an extensive listing as this cannot replace Pearse and Gaydon's (1950) tabulation, which contains the pertinent data on all the more readily observed systems, the utility of the present work, under many circumstances, is obvious.

Upon completion of this summary, I became aware of Lofthus' (1960) work, which is an extensive survey containing not only the wavelengths given here but also a summary of the important work that has been done on the structure of N_2 and N_2^+. Lofthus' survey is directed toward problems in molecular structure, whereas this was compiled to facilitate problems in identification.

In all possible cases I have used Herzberg's (1950) notation for the electronic state designations. Failing this, that of Pearse and Gaydon (1950) was used, and where the bands are discussed by none of these authors, I have used the notation of the original investigator with minor modifications, where necessary, to maintain consistency with earlier designations. In several instances where rotational analyses have not been performed, I have relied on the deductions of Mulliken (1957) as to the type of electronic state involved. The vibrational assignments, particularly in the fragmentary singlet-singlet transitions, are in some instances uncertain. It is likely that some of these systems observed in emission actually have common upper electronic states.

In Table 1 are listed the states of N_2 and N_2^+, along with the observed transitions, the system origins, the extent of the systems, and the names sometimes associated with them. It is intended that this table should serve as an index to the wavelength listings in the succeeding tables. The latter are arranged in four successive groups: the triplet-triplet and higher multiplicity bands, the triplet-singlet bands, and the singlet-singlet bands of N_2, followed by the bands of N_2^+. Within each group the systems are listed according to increasing wave number of the system origin.

The intensities listed for the first and second positive and first negative systems are on a linear scale. The remainder are the usual eye-estimates on a quasi-logarithmic scale.

Calculated wavelengths have been given in some cases where the observed wavelengths are of low quality.

In the appendix are listed the vibrational intervals, $\Delta G_{v+1/2}$. References to rotational analyses and to other works on the vibrational analyses are given in connection with the observed band systems in Tables 2–59.

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Mrs. Pamela Stuefen typed the manuscript, and Mr. T. H. Rau did part of the proofreading. Mr. Rau and Mr. Joseph Wampler also assisted in some of the calculations.

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TABLE I

Series Limit (cm^{-1})	Transition	Extent (A)		Table No.
151240	$B^2\Sigma_u^+ \leftarrow X^1\Sigma_g^+$	661-825	Hopfield's Rydberg series.	54
151240	$B^2\Sigma_u^+ \rightarrow X^1\Sigma_g^+$	661-716	Takamine, Suga and Tanaka's Rydberg series.	55
136607	$A^2\Pi_u \rightarrow X^1\Sigma_g^+$	732-929	Worley's Rydberg series.	53
125666	$X^2\Sigma_g^+ \leftarrow X^1\Sigma_g^+$	785-958	Worley-Jenkins Rydberg series.	52

Upper State		Observed Transitions				
T_{oo} (cm^{-1})	State	Lower State	ν_{oo} (cm^{-1})	Extent (A)		Table No.
103580(H)	$D^3\Sigma_u^+$	$\rightarrow B^3\Pi_g$	44266(H)	2256-2904	Fourth Positive	9
97583(H)*	C'	$\rightarrow B^3\Pi_g$	38270(H)*	2864-5450	Goldstein-Kaplan	8
95770(H)	E	$\rightarrow A^3\Sigma_u^+$	46014(H)	2138-2733	Kaplan's Third	10
88984	$C^3\Pi_u$	$\rightarrow B^3\Pi_g$	29670	2687-5452	Second Positive	7
		$\rightarrow X^1\Sigma_g^+$?	88984	1076-1123	Tanaka	13
65850	$B'^3\Sigma_u^-$	$\rightarrow B^3\Pi_g$	6536	6058-8939		3
		$\rightarrow X^1\Sigma_g^+$	65850	1423-2234	Wilkinson-Ogawa-Tanaka	12
59314	$B^3\Pi_g$	$\rightarrow A^3\Sigma_u^+$	9557	4723-largeλ	First Positive	4
49757	$A^3\Sigma_u^+$	$\rightarrow X^1\Sigma_g^+$	49757	1689-5326	Vegard-Kaplan	11
			4448	1.908μ-2.971μ	Hepner-Herman	2
			12376	7001-8549	Herman's Infrared Bands	5
			17907	5047-6360	Green Bands	6

Continued next page

* The parenthetic H indicates that T_{oo} and ν_{oo} were obtained from band-head measurments.

Upper State		Observed Transitions				
T_{oo} (cm^{-1})	State	Lower State	ν_{oo} (cm^{-1})	Extent (A)		Table No.
121247(H)	v	$\leftarrow X\,^1\Sigma_g^+$	121247(H)	812-825	Worley	51
120585(H)	$u\,^1\Sigma_u^+$	$\leftarrow X\,^1\Sigma_g^+$	120585(H)	822-829	Worley	50
118487(H)	t	$\leftarrow X\,^1\Sigma_g^+$	118487(H)	837-844	Worley	49
116683(H)	s	$\leftarrow X\,^1\Sigma_g^+$	116683(H)	850-857	Worley	48
115562(H)	$e\,^1\Sigma_u^+$	$\rightarrow a\,^1\Pi_g$	46611(H)	2224-2700	Herman	32
115365	$z\,^1\Delta_g$	$\rightarrow w\,^1\Delta_u$	43667	2369-2477	Lofthus	28
114165	$y\,^1\Pi_g$	$\rightarrow w\,^1\Delta_u$	42467	2263-2855	Kaplan's Second	27
		$\rightarrow a'\,^1\Sigma_u^-$	46427	2154-2466	Kaplan's First	31
113211	$x\,^1\Sigma_g^-$	$\rightarrow a'\,^1\Sigma_u^-$	45473	2034-2845	Fifth Positive	30
112769	$h\,^1\Sigma_u^+$	$\rightarrow a\,^1\Pi_g$	43818	2282-2796	Herman-Gaydon	29
		$\leftarrow X\,^1\Sigma_g^+$	112769	887-1208	Watson-Koontz	47
111332(H)	d'	$\rightarrow a\,^1\Pi_g$	42381(H)	2359-2558	Herman	26
110944(H)	$r\,^1\Sigma_u^+$	$\leftarrow X\,^1\Sigma_g^+$	110944(H)	867-901	Worley	46
110656	$s''\,^1\Sigma_u^+$	$\rightarrow a\,^1\Pi_g$	41705	2397-2603	Gaydon	25
110190(H)	f	$\rightarrow X\,^1\Sigma_g^+$	110190(H)	927-1188	Watson-Koontz	45
109833(H)	$q\,^1\Sigma_u^+$	$\leftarrow X\,^1\Sigma_g^+$	109833(H)	875-911	Worley	44
108952	$g\,^1\Sigma_u^+$	$\rightarrow a\,^1\Pi_g^+$	40001	2499	Lofthus	24
		$\rightarrow X\,^1\Sigma_g^+$	108952	938-1236	Watson-Koontz	43
108696	$d'''\,^1\Pi_u$	$\rightarrow a\,^1\Pi_g$	39745	2516-3008	Janin-Crozet	23
108545	$k\,^1\Sigma_u^+$	$\rightarrow a\,^1\Pi_g$	39595	2525-2754	Lofthus	22
107657(H)	$p\,^1\Pi_u$	$\leftarrow X\,^1\Sigma_g^+$	107657	911-929	Worley	42
106510(H)	?	$\rightarrow a\,^1\Pi_g$	37559(H)	2662-3063	Janin-Crozet	21
106368	$r'\,^1\Sigma_u^+$	$\rightarrow a\,^1\Pi_g$	37417	2672-2796	Gaydon	20
105682	$o\,^1\Pi_u$	$\rightarrow a\,^1\Pi_g$	36731	2724-2853	Janin-Crozet	19
		$\leftarrow X\,^1\Sigma_g^+$	105682	897-946	Worley	41
105346	$m\,^1\Pi_u$	$\rightarrow a\,^1\Pi_g$	36395	2746-3175	Herman-Gaydon-Janin	18
		$\leftarrow X\,^1\Sigma_g^+$	105346	935-949	Worley	40

Continued next page

*The parenthetic H indicates that T_{oo} and ν_{oo} were obtained from band-head measurements.

TABLE I

Upper State		Observed Transitions				
T_{00} (cm^{-1})	State	Lower State	ν_{00} (cm^{-1})	Extent (A)		Table No.
104712(H)	d	$\rightarrow a^1\Pi_g$	35761(H)	2796-3417	Herman-Janin	17
104322	$p'^1\Sigma_u^+$	$\rightarrow a^1\Pi_g$	35371	2827-3661	Herman-Gaydon	16
		$\rightarrow X^1\Sigma_g^+$	104322	958	Worley	39
104139	$i^1\Pi_u$	$\rightarrow a^1\Pi_g$	35188	2839-2980	Janin	15
103672	$b'^1\Sigma_u^+$	$\rightarrow X^1\Sigma_g^+$	103672	920-1644	Birge-Hopfield	38
101456(H)	$b^1\Pi_u$	$\rightarrow X^1\Sigma_g^+$	101456(H)	955-1438	Birge-Hopfield	37
		$\rightarrow a^1\Pi_g$	32510	3075-3241	Janin	14
100821(H)	$j^1\Sigma_u^+$	$\rightarrow X^1\Sigma_g^+$	100821(H)	992	Worley	36
98486(H)	i	$\rightarrow X^1\Sigma_g^+$	98486(H)	1002-1015	Worley	35
71698	$w^1\Delta_u$					
68951	$a^1\Pi_g$	$\rightarrow X^1\Sigma_g^+$	68951	1205-2602	Lyman-Birge-Hopfield	34
67738	$a'^1\Sigma_u^-$	$\rightarrow X^1\Sigma_g^+$	67738	1333-2004	Wilkinson-Mulliken-Ogawa-Tanaka	33
0	$X^1\Sigma_g^+$					

N_2^+

	$D^2\Pi_g$	$\rightarrow A^2\Pi_u$		2240-3070	Janin-d'Incan	58
64547	$C^2\Sigma_u^+$	$\rightarrow X^2\Sigma_g^+$	64547	1377-2060	Second Negative	59
25566	$B^2\Sigma_u^+$	$\rightarrow X^2\Sigma_g^+$	25566	2913-5865	First Negative	57
9016	$A^2\Pi_u$	$\rightarrow X^2\Sigma_g^+$	9016	5516-17706	Meinel	56
0	$X^2\Sigma_g^+$					

*The parenthetic H indicates that T_{00} and ν_{00} were obtained from band-head measurements.

4448 cm^{-1} System

Three heads. Degraded to the Red.

Hepner and Herman (1957). The authors illustrate the appearance of the bands. The three heads increase in intensity going to long wavelengths.

λ (Å)	v',v"	λ	v',v"	λ	v',v"
19079. 178. 255.	1,0	22334. 477. 585.	0,0	- - 2.971μ	0,1
20385. 480. 583.	2,1	23930. 24092. 205.	1,1		

6536 cm^{-1} System

$B'\,^3\Sigma_u^- - B\,^3\Pi_g$

Similar to First Positive. Degraded to Red.

The wavelengths and intensities are from LeBlanc, Tanaka, and Jursa (1958). [For the historical background see Brook (1953), Carroll and Sayers (1953) and Kistiakowsky and Warnek (1957).] Carroll and Rubalcava (1959 and 1960) and Dieke and Heath (1960) have performed the rotational analysis and Bayes and Kistiakowsky (1958) appear to have established the vibrational numbering from isotopic analysis.

LeBlanc. Tanaka and Jursa include a half-tone of the spectrum.

λ		Int.	v',v"	λ		Int.	v',v"	λ		Int.	v',v"
6058.	iii	(1)	7,0	7239. 56.	ii iii	(2)	5,0	8247. 58. 81.	i ii iii	(5)	5,1
6200.	iii	(3)	8,1	7408. 16. 35.	i ii iii	(6)	6,1	8458. 69. 93.	i ii iii	(8)	6,2
6578. 83. 98.	i ii iii	(1)	6,0	7591. 99. 7619.	i ii iii	(10)	7,2	8676. 87. 8713.	i ii iii	(10)	7,3
6735. 40. 56.	i ii iii	(6)	7,1	7780. 87. 7809.	i ii iii	(10)	8,3	8900. 12. 39.	i ii iii	(2?)	8,4
6896. 6902. 18.	i ii iii	(8)	8,2	8053. 75.	ii iii	(2)	4,0				

TABLE 4

9357 cm^{-1} System

FIRST POSITIVE

$B\,^3\Pi_g \rightarrow A\,^3\Sigma_u^+$

Four heads at moderate dispersion. Degraded to the violet.

The wavelengths, for the P_1 (long wavelength) heads, were taken from Carroll and Sayers (1953), labelled C, [illegible] and [illegible] (1937), labelled H, and Dieke and Heath (1959). These wavelengths agree to within a few tenths of an Angstrom with those given by Fowler and Strutt (1911) and Birkenbeil (1934) but not with those by Poetker (1928) which appear to be for other heads (Carroll and Sayers, 1953). The calculated wavelengths marked with an asterisk, the calculated and observed intensities on a linear scale, and a review of the work on vibrational and rotational analyses are also given by Dieke and Heath. [See also Carroll (1952) and Feast (1950).]

4723.2*		12,5
4737.0*		11,4
4751.2*		10,3
4766.0*		9,2
4781.4*		8,1
C 4782.4		26,20
C 4794.6		25,19
4797.1*		7,0
C 4808.4		24,18
C 4822.9		23,17
C 4838.4		22,16
C 4854.9		21,15
C 4872.0		20,14
C 4889.5		19,13
C 4907.9		18,12
C 4926.8		17,11
C 4946.3		16,10
C 4966.6		15,9
C 4987.4		14,8
C 5008.9		13,7
5030.7*	(12)	12,6
5053.4*	(8)	11,5
5076.9*	(9)	10,4
5101.0*	(6)	9,3
5125.8*		8,2
5151.3*		7,1
5177.9*	(0)	6,0
5372.1	(52)	12,7
5407.0*	(46)	11,6
5442.2*	(41)	10,5
5478.2*	(39)	9,4
5515.3*	(29)	8,3
5553.4*	(17)	7,2
5592.5*	(13)	6,1
5632.7*	(9)	5,0
5755.2	(170)	12,8
5804.2	(210)	11,7
5854.4	(210)	10,6
5906.0*	(218)	9,5

5959.0*	(192)	8,4
6013.5*	(154)	7,3
6069.7*	(111)	6,2
6127.3*	(73)	5,1
6185.2	(13)	12,9
6186.7	(57)	4,0
6253.1	(131)	11,8
6322.8	(211)	10,7
6394.7	(318)	9,6
6468.6	(408)	8,5
6544.9	(506)	7,4
6623.6	(548)	6,3
6671.5*	(34)	12,10
6704.8	(504)	5,2
6764.0*	(45)	11,9
6788.6	(335)	4,1
6859.3*	(39)	10,8
6875.2	(142)	3,0
6957.8*	(15)	9,7
7059.3*	(0)	8,6
7164.8*	(161)	7,5
7262.4*	(0)	12,11
7274.0	(362)	6,4
7340.8*	(4)	11,10
7387.2	(590)	5,3
7479.0*	(18)	10,9
7504.7	(872)	4,2
7612.9*	(49)	9,8
7626.8*	(833)	3,1
7752.0*	(40)	8,7
7753.7	(719)	2,0
7860.6*	(9)	12,12
7896.9	(166)	7,6
8047.9	(134)	6,5
8073.6*	(20)	11,11
8201.9*	(28)	10,10
8205.3*	(93)	5,4
8370.1*	(95)	4,3
8383.9*	(29)	9,9

8542.5	(305)	3,2
8574.2*	(8)	8,8
8723.0	(862)	2,1
8773.7*	(4)	7,7
8819.7*	(6)	11,12
8912.4	(1260)	1,0
8983.4*	(3)	6,6
9113.6*	(3)	10,11
9203.9* C 9201.9	(180)	5,5
9303.0*	(0)	9,10
9436.4* C 9433.0	(252)	4,4
9564.9*	(2)	8,9
9682.1* C 9680.4	(271)	3,3
9841.8*	(18)	7,8
9942.0* C 9939.9	(214)	2,2
10010.8* C 10133.3	(44)	6,7
10075.8*	(1)	10,12
10217.9*	(7)	1,1
10448.2*	(80)	5,6
10493.7*	(6)	9,11
10510.0* C 10508.3	(1000)	0,0
10779.9*	(6)	8,10
10781.4*	(79)	4,5
11137.9*	(102)	3,4
11169.7*	(21)	7,9
11520.0* H 11516.	(102)	2,3
11588.9*	(23)	6,8
11790.1*	(7)	9,12
11931.0* H 11925.	(261)	1,2

Continued next page

9557 cm^{-1} System

FIRST POSITIVE
Continued

λ in Microns

1.2040*	(16)	5,7
1.2374* H 1.2373	(434)	0,1
1.2412*	(3.1)	8,11
1.2529*	(2)	4,6
1.2863*	(5.6)	7,10
1.3061*	(97)	3,5
1.3474*	(2.2)	6,9
1.3642* H 1.3635	(126)	2,4
1.4147*	(0)	5,8
1.4267*	(0.5)	8,12
1.4278* H 1.4269	(171)	1,3
1.4890*	(4)	4,7
1.4979* H 1.4977	(154)	0,2
1.5326*	(0.2)	7,11
1.5717* H 1.571	(100)	3,6
1.6018*	(0.2)	6,10
1.6642*	(81)	2,5
1.7063*	(2.2)	5,9
1.7687* H 1.768	(98)	1,4
1.8159*	(0.2)	7,12
1.8252* H 1.824	(7)	4,8
1.8874* H 1.887	(24)	0,3
1.9619* H 1.959	(17)	3,7
1.9907*	(1.0)	6,11
2.1210* H 2.117	(18)	2,6
2.1357*	(2.5)	5,10
2.3085* H 2.306	(11)	1,5
2.3414* H 2.340	(3.3)	4,9
2.5154*	(0.7)	6,12
2.5328* H 2.530	(1.2)	0,6
2.5806*	(5.2)	3,8
2.8880*	(1.0)	5,11
2.899*	(3.3)	2,7
3.233*	(0.9)	4,10
3.292*	(1.2)	1,6
3.771*	(1.0)	3,9
3.808*	(0.1)	0,5
4.141*	(0.2)	5,12
4.520*	(0.3)	2,8
5.339*	(0)	4,11
5.642*	(0.1)	1,7
6.786*	(0.1)	3,10
7.506*	(0)	0,6
9.958*	(0)	2,9
12.12*		4,12
18.68*	(0)	1,8
39.37		3,11

12376 cm^{-1} System

HERMAN'S INFRARED BANDS

Six heads. Degraded to the Violet.

The wavelengths and intensities are from Carroll and Sayers (1953). The shortest wavelength head is the strongest. [See also Herman (1951)]

Carroll and Sayers also give a half-tone of the spectrum.

7001.2 vi 09.2 v 14.6 iv 19.3 iii 25.8 ii 33.3 i	(4)	3,1
7061.7 vi 69.8 v 76.3 iv 80.8 iii 87.5 ii 94.4 i	(6)	2,0
7435.0 vi 7471.8 i	(5)	2,1
7521.0 vi 30.7 v 36.5 iv 41.4 iii 50.0 ii 58.3 i	(4)	1,0
7828.5 vi 40.7 v 46.7 iv 53.7 iii 62.0 ii 68.5 i	(8)	2,2
8057.6 vi 70.9 v 77.6 iv 84.7 iii 94.1 ii 8101.1 i	(10)	0,0
8397. vi	(1)	1,2
8549. vi	(2)	0,1

TABLE 6

17907 cm^{-1} System

GREEN BANDS

Complex appearance. Degraded to the Violet.

~~The wavelengths are from Grün (1954), labelled G, and [illegible]. [illegible]~~ an illustration of the appearance of these bands. In Gaydon's (1944) opinion the bands are very similar in appearance to those of the Fourth Positive system and, consequently may be due to a $^3\Sigma - {}^3\Pi$ transition.

Gaydon has included a half-tone of the spectrum.

	λ	Head	Intensity	v′,v″
G	5047.0	i		
	46.8			
	50.7	ii		
	54.0	iii	(2)	3,1
	57.5	iv		
	62.7	v		
G	5073.4	i		
	73.0			
	77.7	ii		
	80.2	iii		
	84.2	iv	(4)	2,0
	90.2	v		
G	90.2			
G	97.0	vi		
G	5272.0	i		
	70.5			
	74.4	ii		
	78.6	iii	(5)	2,1
	83.1	iv		
	89.2	v		
G	90.0			
G	5308.6	i		
	09.5			
	12.9	ii		
	16.7	iii	(8)	1,0
	20.7	iv		
	26.9	v		
G	27.0			
G	33.8	vi		
G	5435.0	i	(3)	3,3
G	5479.6	i		
G	98.	v	(6)	2,2
G	5506.3	vi		
G	5527.1	i	(2)	1,1
G	45.5	v		
G	5574.4	i		
	74.8			
	79.3	ii		
	82.9	iii	(9)	0,0
	87.6	iv		
	95.0	v		
G	94.2			
G	5602.1	vi		
G	5640.	i	(1)	3,4
G	61.	v		
G	5755.1	i	(3)	1,2
G	76.3	v		
G	5815.1	i		
	14.7			
G	36.5	v	(10)	0,1
	39.5			
G	45.4	vi		
G	5924.	i	(1)	2,4
G	5994.5	i		
G	6017.3	v	(6)	1,3
G	26.8	vi		
G	6068.6	i		
G	91.0	v	(8)	0,2
G	6101.1	vi		
G	6160.5	i		
G	83.4	v	(3)	2,5
G	91.6	vi		
G	6246.3	i		
G	68.8	v	(5)	1,4
G	79.7	vi		
G	6336.3	i	(5)	0,3
G	60.4	v		

29670 cm^{-1} System TABLE 7

SECOND POSITIVE

$C^3\Pi_u \rightarrow B^3\Pi_g$

Three very close heads. Degraded to the Violet.

The wavelengths, for the P_1 (long wavelength) heads, are from Carroll and Sayers (1953) and Dieke and Heath (1959) and agree to within 0.1 Å with those of Pankhurst (1950). The intensities, on a linear scale, are from Wallace (unpublished). Dieke and Heath summarize the work on the vibrational and rotational analyses.

2687.		4,0	3500.5	(4.9)	2,3	4343.6		0,4
2814.3		4,1	3536.7	(38)	1,2	4355.0		4,9
2819.8		3,0	3576.9	(60)	0,1	4416.7	(1.4)	3,8
2953.2		4,2	3641.7	(1.4)	4,6	4490.2	(1.4)	2,7
2962.0		3,1	3671.9	(4.5)	3,5	4574.3	(1.0)	1,6
2976.8	(16)	2,0	3710.6	(11)	2,4	4649.4		4,10
3104.0	(5.4)	4,3	3755.5	(22)	1,3	4667.3		0,5
3116.7	(19)	3,2	3804.9	(23)	0,2	4723.5	(0.55)	3,9
3136.0	(38)	2,1	3857.9	(3.3)	4,7	4814.7	(0.36)	2,8
3159.3	(73)	1,0	3894.6	(5.7)	3,6	4916.8		1,7
3268.1	(6.3)	4,4	3943.0	(8.0)	2,5	4976.4		4,11
3285.3	(7.4)	3,3	3998.4	(9.9)	1,4	C 5031.5		0,6
3309.	(2.7)	2,2	4059.4	(5.8)	0,3	C 5066.0		3,10
3338.9	(2.9)	1,1	4094.8	(2.6)	4,8	C 5179.3		2,9
3371.4	(100)	0,0	4141.8	(3.3)	3,7	C 5309.3		1,8
3346.	(0.25)	4,5	4200.5	(4.1)	2,6	C 5452.0		0,7
3469.	(0.23)	3,4	4269.7	(3.3)	1,5			

TABLE 8-9

38270 cm^{-1} System

GOLDSTEIN - KAPLAN

$C' \rightarrow B^3\Pi_g$

Three heads. Degraded to the Red.

The first series of measurements is by Hamada (1937) and the second by Gaydon (1944). Gaydon was not able to find the 2863-2925A bands and felt they belonged to a different system from the 4166-5058 bands. The blue bands appeared to Gaydon to originate from a $^3\Sigma$ or a $^3\Delta$ state.

Gaydon has included a half-tone of the spectrum.

2863.5	0,2	3326.1	0,5	4432.2	0,10
3005.4	0,3	3508.0	0,6	4728.0	0,11
3025.8	1,4	3707.1	0,7	5058.6	0,12
3159.2	0,4	3925.4	0,8		
3178.4	1,5	4166.0	0,9		

4165.7 i 71.6 ii 78.2 iii	(5)	0,9	4728.4 i 35.6 ii 43.8 iii	(3)	0,11	5450. iii		0,13
4432.3 i 38.8 ii 46.2 iii	(4)	0,10	5059.4 i 66.7 ii 76.2 iii	(1)	0,12			

44266 cm^{-1} System

FOURTH POSITIVE

$D^3\Sigma_u^+ \rightarrow B^3\Pi_g$

Five close heads. Degraded to the Violet.

The wavelengths and intensities are from Fowler and Strutt (1911). The five heads appear to correspond to the Q_1, P_1, P_2, O_2, and O_3 branches. Gero and Schmid (1940) have performed a rotational analysis of the 0,1 and 0,2 bands. Gero and Schmid's band head wavelengths are from 0.2 to 0.5 A greater than those given by Fowler and Strutt.

2256.0 57.1 58.4 59.6 60.8	(2)	0,0	2545.3 46.6 48.4 49.7 50.7	(8)	0,3	2896.6 98.1 2900.3 02.0 03.9	(1)	0,6
2346.4 47.5 49.0 50.3 51.4	(6)	0,1	2654.5 55.8 57.9 59.3 60.5	(5)	0,4			
2442.8 44.0 45.6 47.0 48.0	(10)	0,2	2771.4 72.8 75.1 76.5 77.9	(2)	0,5			

46014 cm^{-1} System

KAPLAN'S THIRD

$$E \rightarrow A^3\Sigma_u^+$$

Degraded to the Violet.
The wavelengths are from Herman's (1945) table V.

2137.6	1,1	2315.3	0,2	2497.8	1,6
2203.8	1,2	2391.6	0,3	2554.9	0,5
2243.3	0,1	2419.8	1,5	2642.1	0,6
2272.9	1,3	2471.4	0,4	2733.2	0,7

49757 cm^{-1} System

VEGARD - KAPLAN

$$A^3\Sigma_u^+ \rightarrow X^1\Sigma_g^+$$

Single heads. Degraded to the Red.

The wavelengths are from Bernard (1935), labelled B, Janin (1943b and 1946a), labelled J, Herman (1946), not labelled (the same list is also given by Herman and Herman, 1946), and Wilkinson (1959), labelled W. Those marked with an asterisk were calculated from the A-state analysis of Dieke and Heath (1959), the X-state analysis by Wilkinson (1957), and the system origin determined from the analysis of the 6,0 and 7,0 bands by Wilkinson (1959). The intensities have been scaled from Vegard's (1932) figure 5. Below about 3200 A the wavelengths appear to be accurate to about 0.1 A but above this the observed and calculated wavelengths diverge in a peculiar fashion. The measurements by Janin (1946a) and Wilkinson (1959) are the most accurate. Wilkinson's (1959) report contains the most recent rotational analysis.

Wulf and Melvin (1939) present an interesting half-tone of two of the bands.

λ vac

W 1689.1								
1689.1*		7,0	1807.5*	(1)	4,0	1901.2*	(3)	2,0
W 1726.0			1832.4*		7,2	1922.9*	(1)	5,2
1726.0*	(3)	6,0	1841.4*	(2)	5,1	1936.3*	(4)	3,1
1758.3*		7,1	1852.7*	(1)	3,0	1953.4*		1,0
1765.7*	(1)	5,0	1875.9*		6,2	1972.7*	(1)	4,3
1798.3*	(3)	6,1	1887.0*	(3)	4,1	1989.3*	(4)	2,1

Continued next page

TABLE II

49737 cm^{-1} System

[illegible] - KAPLAN

Continued

λ_{air}

	λ_{air}		
	[illegible].0*	(3)	0,0
	2010.1*		5,3
	2025.9*	(4)	3,2
	2045.9*	(2)	1,1
	2064.0*	(1)	4,3
	2084.1*	(4)	2,2
	2105.1*		5,4
	2107.7*	(4)	0,1
	2123.5 2123.8*	(1)	3,3
	2146.6? 2147.0*	(4)	1,2
	2164.5? 2164.9*	(1)	4,4
	2187.8 2187.8*	(4)	2,3
	2207.2? 2208.1*		5,5
	2215.1 2215.2*	(4)	0,2
	2229.9 2230.1*	(1)	3,4
	2257.2 2257.2*	(4)	1,3
	2274.0 2274.0*	(1)	4,5
	2300.7 2300.8*	(3)	2,4
	2319.7 2320.2*	(1)	5,6
J	2332.6 2332.6 2332.7*	(5)	0,3
	2346.0 2346.0*	(1)	3,5
J	2377.6 2377.6 2377.7*	(4)	1,4
	2393.0*		4,6
	2424.4 2424.4*	(1)	2,5
	2441.8 2442.5	(1)	5,7
J	2461.4 2461.5 2461.8*	(6)	0,4
	2472.5? 2472.9*	(2)	3,6
J	2509.9 2509.8 2509.9	(2)	1,5
	2523.4 2523.4*	(3)	4,7
	25[illegible].1 25[illegible].1*	(3)	2,6
	2576.0 2576.9*	(2)	3,8
J	2603.5 2603.6 2603.0*	(6)	0,5
	2612.3*		3,7
J	2655.6 2655.7 2655.7*		1,6
	2666.6 2666.0*	(3)	4,8
	2709.8 2709.9*	(2)	2,7
	2723.9*	(2)	5,9
J	2760.7 2760.8 2760.8*	(7)	0,6
	2766.2*		3,8
J	2817.1 2817.1 2817.2*	(4)	1,7
	2824.9*	(2)	4,9
	2875.8*	(2)	2,8
	2886.8*	(2)	5,10
J	2935.7 2935.6 2935.7*	(7)	0,7
	2936.8*		3,9
J	2997.0 2996.9 2996.9*	(5)	1,8
	3000.4*		4,10
	3060.7*	(3)	2,9
	3067.6*		5,11
	3127.0*	(3)	3,10
	3131.4*	(7)	0,8
	3196.2*		4,11
J	3198.0 3198.2 3198.2*	(6)	1,9
	3267.8*	(4)	2,10
	3269.4*		5,12
	3340.3*		3,11
	3351.5 3351.8*	(7)	0,9
	3416.0*	(2)	4,12
J	3425.2 3425.1 3425.1*	(5)	1,10
	3496.2*	(2)	5,13
B	3501.9 3502.7 3501.4*	(4)	2,11
B	3581.8 3582.2 3581.1*	(3)	3,12
B	3601.9 3603.0 3601.9*	(5)	0,10
B	3664.5 3664.2*	(2)	4,13
J B	3682.4 3682.8 3683.3 3682.8*	(4)	1,11
B	3749.8 3752.9*	(2)	5,14
B	3766.9 3767.9 3766.9*	(4)	2,12
B	3855.2 3854.7 3854.8*	(2)	3,13
B	3887.9 3889.2 3887.8	(4)	0,11
	3948.1 3946.8*	(3)	4,14
B	3977.9 3979.1 3977.4*	(3)	1,12
B	4071.? 4072.5	(4)	2,13
B	4144.	(3)	6,16
B	4169.? 4171.2	(4)	3,14
B	4219.	(3)	0,12
	4272.3	(4)	4,15
B	4319.8	(2)	1,13
B	4494.6	(4)	6,17
B	4534.5	(4)	3,15
B	4605.4	(2)	0,13
B	4616.5		7,18
B	4649.7	(4)	4,16
B	4718.5	(2)	1,14
B	4837.	(3)	2,15
B	4960.	(3)	3,16
B	5060.	(2)	0,14
B	5326.	(2)	2,16

65850 cm^{-1} System

$B'^3\Sigma_u^- \leftarrow X^1\Sigma_g^+$

Double-headed. Degraded to the Red.

The v'' = 0 progression was observed in absorption by Wilkinson (1960) and the others in emission by Ogawa and Tanaka (1960). Wilkinson (1960) has performed a rotational analysis.

ORIGINS			1695.61 96.50	(1.0) (0.7)	0,3	1993.01 94.30	(1.0) (0.8)	0,7
1423.34		3,0	1717.47 18.36	(1.0) (0.5)	1,4	2018.60 19.78	(0.8) (0.5)	1,8
1453.22		2,0	1762.64 63.45	(1.5) (1.5)	0,4	2081.23 82.54	(0.8) (0.5)	0,8
1484.92		1,0	1808.57 09.31	(0.5) (0.5)	2,6	2135.09 36.33	(1.0) (0.8)	2,10
1518.59		0,0	1834.17 35.33	(1.5) (2.0)	0,5	2176.47 78.06	(0.5) (0.2)	0,9
HEADS			1881.93 83.01	(0.5) (0.5)	2,7	2204.02 05.54	(1.0) (0.8)	1,10
1593.94 94.63	(1.0) (1.0)	1,2	1935.37 36.59	(0.5) (0.3)	1,7	2232.18 33.68	(1.5) (1.0)	2,11
1653.82 54.48	(1.0) (1.0)	1,3						

88984 cm^{-1} System

$C^3\Pi_u \leftarrow X^1\Sigma_g^+$?

Double-headed. Degraded to the Red.

Observed by Tanaka (1955) in absorption.

1075.6	(2)	2,0	1098.3 1098.9	(1) (3)	1,0	1122.6 1123.4	(1) (4)	0,0

32510 cm^{-1} System

$b^1\Pi_u \rightarrow a^1\Pi_g$

Degraded to the Red.

Janin (1946b).

3075.1	0,0	3241.3	0,1

TABLE 18-18

35100 cm^{-1} System

$l^1\Pi_u \rightarrow a^1\Pi_g$

Degraded to the Red.

Janin (1946b, 1939).

2839.4	0,0	2980.1	0,1

35371 cm^{-1} System

$p'^1\Sigma_u^+ \rightarrow a^1\Pi_g$

Close double heads. Degraded to the Violet.

Gaydon's (1943) P system, Herman's (1945, p261) ζ system, Janin (1945) and table XIX of Janin (1946a), and Lofthus (1937).

2827.1	0,0	3118.6	0,2	3463.3	0,4
2967.0	0,1	3283.3	0,3	3661.1	0,5

35761 cm^{-1} System

$d \rightarrow a^1\Pi_g$

Degraded to the Red.

Janin (1943a and 1943e) and table XVI of Janin (1946a), Herman and Herman (1943) and the v'=0 progression of Herman's (1945) θ system (table VI).

2795.5	0,0	3079.9	0,2	3416.5	0,4
2932.0	0,1	3240.9	0,3		

36395 cm^{-1} System

$m^1\Pi_u \rightarrow a^1\Pi_g$

Degraded to the Red.

Gaydon's (1943) Q system, Janin (1943a and 1943e) and table XVI of Janin (1946a), Herman and Herman (1943), and the v'=1 progression of Herman's (1945) θ system (table VI).

2746.2	0,0	3020.4	0,2
2877.9	0,1	3174.8	0,3

36721 cm^{-1} System

$c^1\Pi_u \rightarrow a^1\Pi_g$

Degraded to the Red.

[illegible] and [illegible] ([illegible]) and [illegible] ([illegible]).

2723.6	0,0	2851.3	0,1

37417 cm^{-1} System

$r^1\Sigma_u^+ \rightarrow a^1\Pi_g$

Q bands.

Gaydon's (1943) R system, and Lofthus (1957).

2671.7	0,0	2796.0	0,1

37539 cm^{-1} System

$? \rightarrow a^1\Pi_g$

Degraded to the Violet.

Janin and Crenet (1946).

2661.7	(10)	0,0	2918.5	(6)	0,2
2785.3	(10)	0,1	3062.5	(3)	0,3

39595 cm^{-1} System

$k^1\Sigma_u^+ \rightarrow a^1\Pi_g$

Degraded to the Red.

Lofthus (1957).

2524.9	0,0	2753.8	0,2

TABLE 23-28

39745 cm^{-1} System

$e''\,{}^1\Pi_u \rightarrow c\,{}^1\Pi_g$

Degraded to the Violet.

[illegible] and [illegible] (1946) and [illegible] (1950).

2516.0	(10)	0,0	[illegible]	(3)	0,2	[illegible]	(4)	0,4
2626.2	(1)	0,1	[illegible]	(6)	0,3			

40001 cm^{-1} System

$e\,{}^1\Sigma_u^+ \rightarrow c\,{}^1\Pi_g$

Degraded to the Red.

Lofthus (1957).

2498.6	0,0

41705 cm^{-1} System

$s''\,\Sigma_u^+ \rightarrow c\,{}^1\Pi_g$

Q heads.

Gaydon's (1943) S system, and Lofthus (1957).

2397.1	0,0	2496.8	0,1	2603.3	0,2

42381 cm^{-1} System

$d' \rightarrow c\,{}^1\Pi_g$

Herman's (1945) θ system (table VIII).

2358.8	0,0	2455.1	0,1	2558.	0,2

42467 cm^{-1} System

KAPLAN'S SECOND

$y^1\Pi_g \rightarrow w^1\Delta_u$

Degraded to the Violet.

Gaydon (1943), Herman and Herman (1945), Herman's (1945) α system (table II), and Lofthus and Mulliken (1957).

2263.4	(4)	1,0	2536.6	(5)	0,2	2742.0	(3)	0,4
2354.5	(4)	0,0	2619.3	(5?)	1,4	2831.6		1,6
2431.1		1,2	2636.2	(5)	0,3	2854.9		0,5
2522.4	(3)	1,3	2722.0	(3)	1,5			

43667 cm^{-1} System

$z^1\Delta_g \rightarrow w^1\Delta_u$

Degraded to the Violet.

Lofthus (1957).

2368.8	3,4	2477.3	0,2

43818 cm^{-1} System

$h^1\Sigma_u^+ \rightarrow a^1\Pi_g$

Slightly degraded to the Red.

Gaydon's (1943) T system, Herman's (1945) ε system (p.261), and Lofthus (1957).

2281.5	0,0	2569.6	0,3	2795.6	0,5
2371.6	0,1	2678.6	0,4		

TABLE 30-32

45473 cm^{-1} System

FIFTH POSITIVE

$$x^1\Sigma_g^- \rightarrow a'^1\Sigma_u^-$$

Single Heads. Degraded to the Violet.

The wavelengths are [illegible] (1943), [illegible] and Lofthus [illegible] and appear accurate to about 0.1 A. The intensities are from Gaydon.

2033.6		2,0	2331.1	(2)	1,3	2586.6	(7)	1,6
2097.9	(2)	2,1	2353.6	(4)	0,2	2619.3	(4)	0,5
2112.1	(5)	1,0	2387.9		2,5	2647.1	(2)	2,8
2165.2	(5)	2,2	2411.8	(7)	1,4	2681.5	(5)	1,7
2181.5	(4)	1,1	2469.9	(4)	2,6	2743.2	(1)	2,9
2198.9	(4)	0,0	2496.7	(3)	1,5	2781.6	(3)	1,8
2235.9	(3)	2,3	2525.6	(2)	0,4	2844.6		2,10
2274.3	(6)	0,1	2556.2	(1)	2,7			

46427 cm^{-1} System

KAPLAN'S FIRST

$$y^1\Pi_g \rightarrow a'^1\Sigma_u^-$$

Degraded to the Violet.

Gaydon (1943), Herman's (1945) β system (table III), and Lofthus and Mulliken (1957).

2153.6	(4)	0,0	2301.9	(4)	0,2	2466.0	(2)	0,4
2225.8	(5)	0,1	2366.4	(2)	1,2			
2288.5	(1)	1,3	2381.7	(3)	0,3			

46611 cm^{-1} System

$$e'^1\Sigma_u^+ \rightarrow a^1\Pi_g$$

Degraded to the Violet.

Herman's (1945) η system (table VII).

2224.4	0,1	2397.8	0,3	2592.8	0,5
2308.6	0,2	2492.4	0,4	2699.9	0,6

67738 cm^{-1} System

$a''\,{}^1\Sigma_u^- \longleftarrow X\,{}^1\Sigma_g^+$

Q branches. Degraded to the Red.

The wavelengths of the first [illegible] and the rotational analysis are from Wilkinson and [illegible]. The [illegible] of the 1,0 band [illegible]. The remainder of the table is [illegible]. See also Wilkinson [illegible].

ORIGINS

1332.71	5,0	1476.27*		0,0	1845.64	(3)	0,6
1358.27	4,0	1643.84	(3)	0,3	1922.15	(2)	0,7
1413.87	2,0	1707.00	(4)	0,4	2004.17	(1)	0,8
1444.16	1,0	1774.00	(4)	0,5			

68951 cm^{-1} System

LYMAN - BIRGE - HOPFIELD

$a\,{}^1\Pi_g \longleftarrow X\,{}^1\Sigma_g^+$

Single heads. Degraded to the Red.

The first four vacuum wavelengths are from Birge and Hopfield (1928) and the remaining have been calculated from the constants summarized by Wilkinson (1957). The air wavelengths are from Herman (1945) and the intensities are from Birge and Hopfield. The calculated wavelengths agree with the observations of Birge and Hopfield to about 0.1 A and those of Wilkinson and Houk (1956), Lofthus (1956a), and Wilkinson (1957), labelled H, L, and W respectively, to about 0.01 A. The literature cited for 1956 and 1957 and the report by Wilkinson and Mulliken (1957) deal with the fine structure analysis.

λ_{vac}

B	1205.3		9,0		1444.17	(4)	3,2		1599.67	(4)	3,5
B	1226.6		8,0	W	1450.12	(5)	0,0	H	1611.41	(9)	0,3
B	1249.3	(1)	7,0		1458.70		4,3		1615.26		4,6
B	1262.9	(1)	8,1		1464.21	(8)	1,1		1626.56	(6)	1,4
	1273.24	(4)	6,0		1473.50	(4)	5,4		1631.13		5,7
	1298.50	(5)	5,0		1478.56	(2)	2,2		1641.97		2,5
	1312.16	(4)	6,1		1488.58	(2)	6,5		1647.28	(1)	6,8
	1325.26	(6)	4,0		1493.17		3,3		1657.64	(4)	3,6
	1339.00	(4)	5,1		1500.82	(7)	0,1	H	1671.86	(8)	0,4
	1353.01		6,2		1508.05	(3)	4,4		1673.98		4,7
	1353.65	(8)	3,0		1515.26	(5)	1,2	H	1687.35	(9)	1,5
	1367.47	(2)	4,1		1523.22	(1)	5,5		1689.79		5,8
	1381.56	(2)	5,2		1529.96	(5)	2,3		1703.10	(4)	2,6
W	1383.82	(8)	2,0		1538.66		6,6		1706.29		6,9
	1395.93	(3)	6,3		1544.93	(0)	3,4		1719.11	(2)	3,7
	1397.73		3,1	H	1554.50	(9)	0,2		1735.39		4,8
	1411.90	(5)	4,2		1560.17	(3)	4,5		1736.14	(5)	0,5
W	1418.92	(6)	1,0		1569.29		1,3		1751.94		5,9
	1426.34	(1)	5,3		1575.68	(3)	5,6		1751.97	(7)	1,6
	1429.92	(6)	2,1		1584.33	(5)	2,4		1768.86	(6)	2,7
	1441.07		6,4		1591.49	(0)	6,7				

Continued next page

TABLE 34-38

68951 cm^{-1} System

LYMAN - BIRGE - HOPFIELD
Continued

1768.77		6,10
1784.40	(3)	3,8
1801.00		4,9
1804.62	(3)	0,6
1817.87		5,10
1820.78	(5)	1,7
1835.01	(1)	6,11
1837.18	(5)	2,8
1853.84	(1)	3,9
1870.75	(4)	4,10
1877.71		0,7
1887.91	(0)	5,11
1894.17	(2)	1,8
1905.35		6,12
1910.87	(4)	2,9
1927.81.	(4)	3,10
L 1945.00	(4)	4,11
1955.87		0,8
L 1962.44	(1)	5,12
1972.60	(0)	1,9

L 1980.14		6,13
L 1988.57	(1)	2,10
L 2006.76	(2)	3,11
L [illegible]	(2)	4,12
L 2041.87		5,13
2056.57		1,10
L 2059.79		6,14
2073.76		2,11
2091.17	(1)	3,12
2108.81		4,13
L 2126.67		5,14
L 2144.76		6,15

λ_{air}

2108.1	4,13
2125.9	5,14
2144.0	6,15
2181.1	3,13
2198.7	4,14

2216.6	5,15
2234.8	6,16
2253.4	7,17
2271.7	8,18
2278.3	3,14
2290.5	9,19
2309.4	10,20
2328.3	11,21
2366.7	13,23
2369.0	8,19
2387.6	9,20
2406.3	10,21
2425.1	11,22
2462.9	13,24
2472.6	8,20
2481.7	14,25
2509.7	10,22
2565.2	13,25
2601.9	15,27

96486 cm^{-1} System **

$I \leftarrow X^1\Sigma_g^+$

Worley (1943).

1001.7	(0^+)	2,0
1008.5	(0)	1,0
1015.37	(0^-)	0,0

100821 cm^{-1} System **

$j^1\Sigma_u^+ \leftarrow X^1\Sigma_g^+$

Single head. Degraded to the Red.

Worley (1943).

991.85	(2^+)	0,0

**The relative intensities of the bands reported by Worley (1943) are all on the same scale.

101456. cm^{-1} System **

$b^1\Pi_u \leftarrow X^1\Sigma_g^+$

Single heads. Degraded to the Red.

The first six bands were observed in absorption by Worley (1943) and the remainder by Birge and Hopfield (1928) in emission.

?955.08	(2)	5,0	1008.6	(5)	0,1	1226.4	(9)	0,9
?960.21	(7)	4,0	1032.6	(10)	0,2	1258.4	(9)	0,10
965.63	(12)	3,0	1057.4	(10)	0,3	1291.7	(9)	0,11
972.1	(15)	2,0	1083.1	(10)	0,4	1326.2	(9)	0,12
978.87	(10)	1,0	1109.9	(5)	0,5	1362.0	(7)	0,13
985.65	(2)	0,0	1166.0	(2)	0,7	1399.3	(4)	0,14
			1195.7	(5)	0,8	1438.0	(2)	0,15

103672 cm^{-1} System

$b'^1\Sigma_u^+ \leftarrow X^1\Sigma_g^+$

Single heads. Degraded to the Red.

The wavelengths of the v'=0, 1, 2, and 3 progressions have been calculated from the fine structure analyses of Tschulanowsky (1935), Wilkinson and Houk (1956) and Lofthus (1956a). The remainder are from the observations of Worley (1943) and Wilkinson and Houk. The intensities in single parentheses are from Birge and Hopfield (1928) while those in double parentheses are from Watson and Koontz (1934).

920.0		7,0	1058.1		3,5	1244.2	(4)	1,11
925.9		6,0	1066.2		2,5	1252.8	((3))	3,12
931.7		5,0	1074.6	(2-)	1,5	1255.8	(5)	0,11
937.7		4,0	1083.1		3,6	1264.3		2,12
944.5		3,0	1083.2	(4)	0,5	1276.1	(3)	1,12
951.0		2,0	1091.7	((3))	2,6	1284.7	((2))	3,13
957.7		1,0	1100.5	(3)	1,6	1288.3	(5)	0,12
964.5		0,0	1109.0		3,7	1296.8		2,13
965.8		3,1	1109.1		6,8	1309.2		1,13
972.6		2,1	1109.5	(4)	0,6	1322.1	(4)	0,13
979.5		1,1	1118.0	((7))	2,7	1330.5		2,14
986.7		0,1	1127.2	(4)	1,7	1343.6		1,14
987.7		3,2	1135.8		3,8	1357.1	(6)	0,14
994.8		2,2	1136.7	(4)	0,7	1379.2		1,15
995.7		5,3	1145.2	((4))	2,8	1393.5	(4)	0,15
1002.1		1,2	1154.9	(6)	1,8	1416.2		1,16
1009.6		0,2	1163.6		3,9	1431.3	(5)	0,16
1010.3		3,3	1164.9	(5)	0,8	1454.7		1,17
1011.7		6,4	1173.4	((3))	2,9	1470.6	(5)	0,17
1017.8	((0))	2,3	1183.6	(7)	1,9	1494.5		1,18
1025.4		1.3	1192.3	((1))	3,10	1511.3	(4)	0,18
1033.3		0,3	1194.1	(5)	0,9	1535.9		1,19
1033.8		3,4	1202.7	((2))	2,10	1553.7		0,19
1034.7		6,5	1213.3	(5)	1,10	1579.0		1,20
1041.6	((3))	2,4	1222.0	((1))	3,11	1597.7	(1)	0,20
1049.6		1,4	1224.4	(5)	0,10	1623.8		1,21
1057.9	(3)	0,4	1232.9	((1))	2.11	1643.6	(0)	0,21

**The relative intensities of the bands reported by Worley (1943) are all on the same scale.

TABLE 39-42

104322 cm^{-1} System**

$p'^{1}\Sigma_u^+ \leftarrow X^1\Sigma_g^+$

Double head. Degraded to the Red.

Worley (1943).

958.17	(2?)	0,0
958.63	(3?)	

105346 cm^{-1} System**

$m^1\Pi_u \leftarrow X^1\Sigma_g^+$

Single heads. Degraded to the Red.

Worley (1943).

935.15	(1)	2,0?	942.39	(3)	1,0	949.22	(2)	0,0

105682 cm^{-1} System**

$o^1\Pi_u \leftarrow X^1\Sigma_g^+$

Single heads. Degraded to the Red.

Worley (1943, 1953).

882.41	(1/2)	4,0	912.62	(5)	2,0	946.12	(1)	0,0
897.18	(3)	3,0	928.88	(6)	1,0			

107657 cm^{-1} System**

$p^1\Pi_u \leftarrow X^1\Sigma_g$

Single heads. Degraded to the Red.

Worley (1943).

910.48	(1-)	3,0	922.75		1,0	928.88?		0,0
916.42	(3)	2,0						

**The relative intensities of the bands reported by Worley (1943) are all on the same scale.

108952 cm^{-1} System

$g^1\Sigma_u^+ \rightarrow X^1\Sigma_g^+$

Degraded to the Red.

Watson and Koontz (1934).

938.03	(1)	0,1	1024.68	(2)	0,5	1123.25	(2)	0,9
958.71	(0)	0,2	1048.24	(0)	0,6	1177.27	(1)	0,11
980.22	(1)	0,3	1072.42	(3)	0,7	1206.28	(3)	0,12
1001.99	(2)	0,4	1097.26	(1)	0,8	1235.79	(1)	0,13

109833 cm^{-1} System **

$q^1\Sigma_u^+ \leftarrow X^1\Sigma_g^+$

Single heads. Degraded to the Red.

Worley (1943).

875.24	(1/4)	7,0	888.81	(1/2)	4,0	904.73	(2)	1,0
879.47	(1/4)	6,0	893.86	(1)	3,0	?910.48	(1^-)	0,0
883.91	(1/2)	5,0	899.20	(2)	2,0			

110190 cm^{-1} System

$f \rightarrow X^1\Sigma_g^+$

Degraded to the Red.

Watson and Koontz (1934).

927.12	(2)	0,1	1011.84	(4)	0,5	1107.85	(3)	0,9
947.43	(1)	0,2	1034.75	(2)	0,6	1160.42	(1)	0,11
968.34	(1)	0,3	1058.32	(1)	0,7	1188.33	(1)	0,12
989.66	(2)	0,4	1082.78	(1)	0,8			

110944 cm^{-1} System **

$r^1\Sigma_u^+ \leftarrow X^1\Sigma_g^+$

Single heads. Degraded to the Red.

Worley (1943).

866.76	(3)	7,0	880.72	(4)	4,0	?896.19	(1^+)	1,0
?871.40	(3?)	6,0	885.66	(2)	3,0	?901.35	(1^-)	0,0
875.87	(3^+)	5,0	890.95	(2)	2,0			

**The relative intensities of the bands reported by Worley (1943) are all on the same scale.

TABLE 47-81

112769 cm^{-1} System

$h\,{}^1\Sigma_u^+ \leftarrow X\,{}^1\Sigma_g^+$

Single heads. Degraded to the Red.

The 0,0 band was observed by Worley (1943) in absorption and the remainder by Watson and Koontz (1934) in emission.

886.69		0,0	1053.15	(2)	0,8	1153.11	(1)	0,12
986.06	(2)	0,5	1077.17	(3)	0,9	1180.49	(1)	0,13
1007.80	(2)	0,6	1127.22	(3)	0,11	1208.17	(0)	0,14
1030.17	(1)	0,7						

116683 cm^{-1} System **

$s \leftarrow X\,{}^1\Sigma_g^+$

Single heads. Degraded to the Red.
Worley (1943).

849.71	(4)	2,0	853.19	(5)	1,0	856.98	(2^+)	0,0

118487 cm^{-1} System **

$t \leftarrow X\,{}^1\Sigma_g^+$

Single heads. Degraded to the Red.
Worley (1943).

837.31	(2^+)	2,0	840.55	(3)	1,0	843.97	(3^+)	0,0

120585 cm^{-1} System **

$u\,{}^1\Sigma_u^+ \leftarrow X\,{}^1\Sigma_g^+$

Single heads. Degraded to the Red.
Worley (1943).

822.12	(0)	2,0	825.65	(1?)	1,0	829.29	(5)	0,0

121247 cm^{-1} System **

$v \leftarrow X\,{}^1\Sigma_g^+$

Single heads. Degraded to the Red.
Worley (1943).

812.37	(1)	2,0	818.53		1,0	824.76	(1)	0,0

**The relative intensities of the bands reported by Worley (1943) are all on the same scale.

WORLEY - JENKINS RYDBERG SERIES (ABSORPTION) **

$$X^2\Sigma_g^+ - X^1\Sigma_g^+$$

Double heads for m ≤ 8 and v' = 0, 2, 3 and 4; otherwise single. The short wavelength heads are given here. Degraded to the Violet.

Worley (1943). The upper states, which other than m = 2 may be $^1\Pi_u$ states, converge to the $X^2\Sigma$ state of N_2^+.

	m	v'		m	v'		m	v'
784.75	16	1	797.29	21	0	803.81	(1⁺) 9	0
785.09	15	1	797.44	20	0	805.90	8	0
785.51	14	1	797.63	19	0	808.91	7	0
786.67	12	1	797.84	18	0	813.52	6	0
787.48	11	1	798.08	17	0	820.04?	(0⁺) 4	1
788.54	10	1	798.37	16	0	821.11	(1/2) 5	0
790.02	9	1	798.72	(1/2⁻) 15	0	834.11?	(1/2) 3	2
795.8	Series Limit	0	799.15	(1/2?) 14	0	834.95	4	0
796.77	26	0	799.38	(0⁺) 6	1	865.06	(1) 3	0
796.85	25	0	799.68	(1/2⁺) 13	0	886.03	(1/4) 2	4
796.94	24	0	800.35	(1/2⁺?) 12	0	902.58	(2) 2	3
797.04	23	0	801.21	11	0	920.04	(3⁺?) 2	2
797.16	22	0	802.33	10	0	938.57	(8) 2	1
						958.17	(2) 2	0

WORLEY'S RYDBERG SERIES (ABSORPTION) **

$$A^2\Pi_u - X^1\Sigma_g^+$$

(v' = 1)

Single heads. Degraded to the Red.

Worley (1943 and 1953). The upper states appear to converge to the $A^2\Pi_{1/2}$ state of N_2^+. The wavelength of the series limit was calculated.

732.03	Series Limit		756.80	(3⁻)	5	806.48	3
749.02	(2⁺)	6	771.72	(2)	4	928.88	2

HOPFIELD'S RYDBERG SERIES (ABSORPTION)

$$B^2\Sigma_u^+ - X^1\Sigma_g^+$$

Takamine, Suga, and Tanaka (1938). The last band is from Worley (1943). The wavelength of the series limit was calculated. The upper states converge to the $B^2\Sigma$ state of N_2^+.

661.2	Series Limit	667.5	9	682.5	5
665.7	11	669.1	8	695.0	4
666.4	10	671.5	7	723.7	3
		675.4	6	825.5	2?

**The relative intensities of the bands reported by Worley (1943) are all on the same scale.

TABLE 56-56 TAKAMINE, SUGA AND TANAKA'S RYDBERG SERIES (EMISSION)

$B^2\Sigma_u^+ \rightarrow X^1\Sigma_g^+$

Takamine, Suga and Tanaka (1938). The wavelength of the series limit was calculated. The upper states converge to the $B^2\Sigma$ state of N_2^+.

661.2	Series Limit	674.0	6	690.6	4
670.4	7	679.8	5	715.5	3

N_2^+ MEINEL BANDS

$A^2\Pi_u \rightarrow X^2\Sigma_g^+$

Two dominant heads. Degraded to the Red.

The wavelengths for the R_2 and Q_1 heads are from Douglas (1953) where the calculated positions are marked with an asterisk. The intensities, on a linear scale, are from Meinel (1951a). The rotational and vibrational analysis has been discussed by Meinel (1950a and b, 1951a and b), Dalby and Douglas (1951), Douglas (1953), Liu (1959), and Mathews and Wallace (1961).

5515.6* 39.8*		5,0	8545.7* 8603.9*	5,3	12249. * 369. *	3,3
6106.4* 36.2*		4,0	9145.3* 9212.1	1,0	12867. * 13001. *	4,4
6267.6* 98.9*		5,1	9431.2* 9502.3*	2,1	13366. * 510. *	5,5
6853.0* 90.5	(4)	3,0	9733.3* 9808.9*	3,2	14523. * 692. *	0,1
7036.8* 81.4*	(5) (5)	4,1	11052. * 10133. *	4,3	15114. * 297. *	1,2
7239.9* 81.8*	(6)	5,2	10499. * 587. *	5,4	15748. * 947. *	2,3
7825.7 74.6	(42) (63)	2,0	11036. * 134. *	0,0	16703. * 927. *	3,4
8053.6 8105.4	(22) (31)	3,1	11416. * 521. *	1,1	17459. * 705. *	4,5
8293.4 8348.3	(5) (8)	4,2	11820. * 932. *	2,2	17460. * 706. *	5,6

TABLE 57

N_2^+ FIRST NEGATIVE

$$B^2\Sigma_u^+ \rightarrow X^2\Sigma_g^+$$

Mostly single heads. Degraded to the Violet.

The intensities, on an expanded scale, and the wavelengths of the main (violet degraded) part of the system are from Herzberg (1928), augmented with the data of Merton and Pilley (1925). Perturbations cause some of the bands to appear double headed. The rotational and vibrational constants are summarized by Douglas (1952).

The wavelengths of the tail bands are from Herzberg (1928), labelled H, Douglas (1952), labelled D, and Janin and Eyraud (1954). The latters wavelengths are only accurate to about 0.5 A. The intensities are from Janin and Eyraud.

3076.4?	(1)	4,1
3078.2?	(1)	3,0
3293.9	(80)	4,2
3299.1	(60)	3,1
3308.8		2,0
3533.2	(100)	5,4
3538.0	(100)	4,3
3548.2	(200)	3,2
3564.4	(300)	2,1
3582.5	(300)	1,0
3818.1		4,4
3835.4		3,3
3857.9	(40)	2,2
3884.3	(250)	1,1
3914.4	(1500)	0,0
4110.9	(2)	6,7
4120.7 21.3	(4) (6)	5,6
4140.7	(20)	4,5

4166.4 66.8	(30) (30)	3,4
4199.2	(100)	2,3
4236.5	(250)	1,2
4278.1	(400)	0,1
4459.3	(5)	7,9
4466.6	(20)	6,8 8,10
4485.3 85.9	(10) (15)	5,7
4489.?	(2)	9,11
4515.9	(35)	4,6
4553.2 54.4	(25) (30)	3,5
4599.9	(50)	2,4
4651.9	(50)	1,3
4709.3	(50)	0,2
4864.4	(6)	7,10 8,11
4881.7	(4)	6,9
4883.3? 84.6?	(1) (1)	9,12

4913.2	(4)	5,8
4958.0	(5)	4,7
5010.8 12.4	(3) (3)	3,6
5076.5	(5)	2,5
5148.8	(4)	1,4
5228.3	(2)	0,3
5328.9 30.0	(0.4) (0.4)	8,12
5340.2	(0.7)	7,11
5344.7	(0.4)	9,13
5372.3	(0.7)	6,10
5384.3	(0.5)	10,14
5420.8	(0.7)	5,9
5450.0	(0.4)	11,15
5485.8	(1)	4,8
5560.8 63.8	(0.5) (0.5)	3,7
5653.?	(0.7)	2,6
5754.4	(0.5)	1,5
5864.7		0,4

FIRST NEGATIVE TAIL BANDS

2912.5	(3)	12,7
2970.0	(0)	13,8
H 2987.5		10,6
2992.3	(2)	18,11
H 3033.0		11,7
3148.5	(0)	13,9
3159.8	(4)	20,13
H 3174.4		10,7
3181.9	(3)	16,11
3217.7 D 3217.1	(3)	14,10
H 3222.7 D 3222.3		11,8
3250.1	(8)	19,13
3263.0	(8)	17,12
3341.7	(8)	20,14
3345.7	(8)	13,10 22,15
3349.6	(8)	18,13

3374.6	(2)	16,12
H 3381.5		10,8
3419.6 D 3419.1	(1)	14,11
3439.2	(2)	21,15
3443.7	(4)	19,14
3447.3	(1)	23,16
3493.4	(1)	12,10
3500.6	(0)	15,12
3534.0	(0)	18,14
3588.6 D 3587.9	(2)	16,13
H 3612.2		10,9
3643.2 D 3643.4	(4)	14,12
3646.1	(5)	21,16
3655.7	(7)	19,15
3668.1	(6)	11,10
3682.1	(7)	17,14

D 3691.0		27,19
D 3726.0		29,20
3730.3 D 3730.4	(5)	15,13
3733.1 D 3733.1	(6)	12,11
3756.1 D 3756.6	(5)	22,17
3761.6	(10)	20,16
3782.8	(8)	18,15
D 3783.4		26,19
3808.9 D 3808.7	(2)	13,12
3824.7	(4)	16,14
3875.1	(6)	10,10
3891.8	(6)	19,16
D 3907.1		27,20
D 3940.1		29,21
3994.9	(3)	22,18

Continued next page

TABLE 57-58

FIRST NEGATIVE TAIL BANDS
Continued

4006.7	(4)	20,17	4969,3	(3)	15,17	5292.9	(7)	20,21
4720.2	(1)	16,17	4988.2	(5)	18,19	5391.1	(3)	18,20
4743.1	(5)	13,15	5066.2	(3)	21,21	5458.2	(2)	21,22
4769.3	(2)	19,19	5099.8	(3)	16,18	5551.9	(1)	19,21
4850.7 D 4850.3	(8)	14,16	5136.4	(8)	19,20	5632.1	(0)	22,23
4913.5	(4)	20,20	5227.7	(3)	22,21	5721.9	(1)	20,22
			5240.2	(5)	17,19			

$D^2\Pi_g \rightarrow A^2\Pi_u$

Double headed. Degraded to the Red.

The wavelengths and intensities are from Tanaka, Namioka and Jursa (1961). The authors have also confirmed the vibrational numbering by isotopic analysis. Grandmontagne, Janin, and d'Incan (1959) cite a rotational analysis by Janin and d'Incan (1958b). See also Janin and d'Incan (1958a).

2057.0 59.5	(3)	10,1	2374.2 77.6	(5)	6,3	2659.7 63.8	(6)	7,6
2086.0 88.6	(4)	9,1	2377.1 80.3	(6)	11,5	- 2705.3	(2)	4,5
2115.9 19.4	(5)	8,1	2414.7 18.0	(1)	10,5	2713.2 17.5	(6)	6,6
2149.6 52.2	(6)	7,1	2418.5 21.8	(5)	5,3	- 2766.1	(2)	3,5
2169.5 72.2	(6)	9,2	2454.4 58.0	(1)	9,5	2770.8 75.3	(1)	5,6
2202.8 05.5	(7)	8,2	2465.6 69.0	(2)	4,3	2804.2 08.8	(15?)	9,8
2224.3 27.2	(4)	10,3	2497.5 2501.0	(2)	8,5	- 2837.4	(0)	4,6
2238.3 41.2	(10)	7,2	2527.5 31.2	(2)	5,4	2843.4 48.6	(?)	6,7
2276.3 79.4	(7)	6,2	2543.4 46.8	(7)	7,5	2860.2 64.9	(4)	8,8
2316.1 19.3	(2)	10,4	2578.6 82.7	(3)	4,4	2907.3 12.4	(2)	5,7
2316.7 19.8	(4)	5,2	- 2613.8	(1)	8,6	2920.7 25.6	(10)	7,8
2332.2 36.3	(5)	7,3	2634.4 38.2	(3)	3,4	3067.4 72.9	(1)	7,9
2359.8 63.1	(1)	4,2	2644.6 48.7	(2)	5,5			

TABLE 59

N_2^+ SECOND NEGATIVE

$C^2\Sigma_u^+ \rightarrow X^2\Sigma_g^+$

Single heads. Degraded to the Red.

The bulk of the wavelengths and all of the intensities are from Tanaka (1953). Additional wavelengths are from the high-resolution studies of Wilkinson (1956), labelled W, and Carroll (1959), labelled C.

λ_{vac}		
1377.4	(2)	4,0
1415.6	(3)	3,0
1460.8	(3)	3,1
1464.3	(2)	4,2
1507.8	(2)	3,2
1511.2	(2)	4,3
1557.6	(5)	3,3
1559.2	(5)	4,4
1609.5	(4)	3,4
1611.4	(5)	4,5
C 1660.22		0,2
1664.4 C 1664.21	(3)	3,5
1721.8	(6)	3,6 4,7
W 1721.79		3,6
1778.8	(0)	6,10
1780.0	(0)	5,9
1781.5	(0)	4,8
1784.4	(1)	0,4 1,5
1841.4 W 1841.45	(0)	5,10
1843.8 W 1843.93	(3)	4,9
1846.2 W 1846.29	(6)	3,8
1848.6 C 1848.41	(0)	2,7
1850.5 C 1850.25	(0)	1,6
1851.9	(0)	0,5
1893.6	(0)	8,14
1897.5	(0)	7,13
1901.6 C 1901.75	(3)	6,12
1905.7 C 1905.82 W 1905.83	(4)	5,11
1909.6 C 1909.81 W 1909.84	(5)	4,10
1913.5 C 1913.65 W 1913.64	(6)	3,9
1917.4 C 1917.21	(0)	2,8
1920.7 C 1920.46	(0)	1,7
1923.4 C 1923.24	(0)	0,6
1955.9	(0)	8,15
1962.1	(1)	7,14
1967.7 C 1967.76	(3)	6,13
1973.5 C 1973.52	(5)	5,12
1979.2 C 1979.21 W 1979.23	(6)	4,11
1984.6 C 1984.69 W 1984.75	(7)	3,10
1990.1	(0)	2,9
1994.9	(0)	1,8
2029.2	(0)	7,15
2037.1	(0)	6,14
2044.7	(1)	5,13
2052.2	(2)	4,12
2059.7	(3)	3,11

APPENDIX

$\Delta G_{v+1/2}$

(cm^{-1})

v	C′ (H)*	E (H)	$C^3\Pi_u$	$B'^3\Sigma_u^-$	$B^3\Pi_g$	$A^3\Sigma_u^+$	$X^1\Sigma_g^+$			
0	1396.	2184.	1994.95	1493.6	1705.50	1432.91				2329.66
1			1941.58	1468.6	1676.34	1405.24				2301.17
2			1875.26	1444.6	1647.44	1377.42				2272.61
3			1783.09	(H)	1618.44	1349.66	2249.6			2243.97
4				1397.	1589.31	1321.72	2215.1			2215.26
5				1374.	1560.28	1293.56	2186.8			2186.47
6				1351.	1531.10	1265.21	2156.5			2157.62
7				1328.	1501.79	1236.63	2128.8			2128.68
8					1472.33	1207.69	2099.2			2099.67
9					1442.76	1178.07	2070.0			2070.59
10					1413.08	1148.39	2041.4	2041.4		2041.43
11					1383.15	1118.58	2011.9	2012.3		2012.20
12					1353.27			1982.9	(H)	1982.90
13					1324.07		1953.8	1953.5	1955.	1953.51
14					1291.55		1923.6	1924.1	1924.	1924.06
15					1260.42		1892.5		1894.	1894.53
16					1229.23		1870.5			1864.93
17							1829.5			1835.25
18							1805.0		1807.	1805.50
19							1775.3		1775.	1775.67
20							1745.7		1743.	1745.77
21									1713.	
22										
23									1650.	
24									1618.	

STATE	SOURCES
C	Hamada (1937).
E	Herman (1945).
C, B, A	Dieke and Heath (1959).
B′	v = 4 to 7 LeBlanc, Tanaka and Jursa (1958); v = 1 to 3 Wilkinson (1960);
X	v = 13 to 20 Tschulanousky (1935), quoted by Lofthus (1956a);
	v = 13 to 15, 18 to 21, 23 and 24 from the observations of Herman (1945);
	v = 3 to 11 from the observations of Wilkinson and Houk (1956);
	v = 10 to 14 Lofthus (1956a);
	v = 0 to 20 calculated values from Lofthus' (1956a) equation.

*The parenthetic H indicates that ΔG was obtained from band-head measurements.

v	Hepner-Herman Bands Upper State (H)	Hepner-Herman Bands Lower State (H)	Green Bands Upper State (H)	Green Bands Lower State (H)	Herman's Infrared Bands Upper State (H)	Herman's Infrared Bands Lower State (H)	v (H)	$u^1\Sigma_u^+$ (H)	t (H)	s (H)	$x^1\Sigma_g^-$
0	765.	1063.	897.7	742.7	885.4	712.0	923.	533.	482.	522.	1868.4
1	728.		873.0	718.0	864.6	665.9	928.	519.	460.	479.	1827.4
2			847.0	695.0	833.2						
3				670.5							
4				648.0							
5											

v	$r^1\Sigma_u^+$ (H)	$q^1\Sigma_u^+$ (H)	$p^1\Pi_u$ (H)	$o^1\Pi_u$ (H)	$m^1\Pi_u$ (H)	$b'^1\Sigma_u^+$	$b^1\Pi_u$ (H)	i (H)	$w^1\Delta_u$	$a^1\Pi_g$	$a^1\Pi_g$ (H)
0	639.?	697.?	715.?	1963.	764.	742.3	698.	669.		1666.1	
1	657.?	681.	749.	1917.	822.?	732.6	709.	671.		1638.4	
2	670.	663.	712.	1885.		722.9	693.		1488.9	1610.7	
3	633.	638.		1866.		752.2	588.?		1465.9	1583.2	1588.
4	629.	622.				704.0	560.?		1442.8	1555.4	1557.
5	607.	572.							1420.1	1527.8	1527.
6	592.	550.									
7											
8											1443.
9											1418.
10											1391.
11											
12											
13											1311.

STATE	SOURCE
Hepner-Herman	Hepner and Herman (1957).
Green Bands	Grün (1954).
Herman's Infrared Bands	Carroll and Sayers (1953).
v, u, t, s, r, q, p, m, b, i	Worley (1943).
x	Lofthus (1956b).
o	Worley (1953).
b′	From the observations of Wilkinson and Houk (1956).
w	Lofthus and Mulliken (1957).
a	v=0 to 5 Lofthus (1956a). The remainder from the observations of Herman (1945).

APPENDIX Continued

v	$a'^1\Sigma_u^-$	$D^2\Pi_g$ (H)	$C^2\Sigma_u^+$	$B^2\Sigma_u^+$	$A^2\Pi_u$ (H)		$X^2\Sigma_g^+$
0	1505.6		2051.1	2371.5			2174.8
1	1482.2		2029.7	2318.8	1843.2	1843.2	2142.2
2	1458.6		2004.3	2260.4	1813.3	1813.4	2109.4
3	1435.7	812.5	1976.0	2196.4	1783.4	1783.6	2076.4
4	1412.3	789.4	1946.1	2122.8	1753.6		2043.0
5	1389.7	766.4	1913.0	2041.0	1723.8		2009.2
6	1366.9	743.5		1951.1	1693.9		1975.7
7	1344.4	720.5		1838.2	1664.1		1939.9
8	1322.1	697.8		1726.9	1634.3		1907.0
9	1299.9	675.0		1596.7			1872.1
10		652.4		1479.9			1836.8
11		629.8		1371.4			1801.1
12		607.2		1276.3			1764.8
13		584.8		1196.3			1728.1
14				1126.6			1691.1
15				1067.1			1653.5
16				1015.5			1615.4
17				966.			1576.8
18				922.			1537.3
19				882.			1497.7
20				845.			1458.2
21				810.			
22				775.			
23				744.			
24				717.7			
25				690.3			
26				661.8			
27				637.6			
28				607.4			

	STATE	SOURCE
	a′	Lofthus (1956b).
N_2^+:	D	Tanaka, Namioka, and Jursa (1961).
	C	Carroll (1959).
	B,X	The summary by Douglas (1952).
	A	v=1 to 3 Douglas (1953); v=1 to 8 Tanaka, Namioka, and Jursa (1961).

APPENDIX Continued

RYDBERG SERIES

	Worley-Jenkins (Worley, 1943).				Worley (Worley, 1953).	
m	$\Delta G_{1/2}$	$\Delta G_{3/2}$	$\Delta G_{5/2}$	$\Delta G_{7/2}$	$\Delta G_{1/2}$	$\Delta G_{3/2}$
2	2180.	2146.	2103.	2069.	1962.	1917.
3					1927.?	
4	2179.					1863.
5					1886.	1860.?
6	2174.?				1883.	1853.?
9	2172.					
10	2178.?					
11	2176.?					
12	2174.					
13	2174.					
14	2174.					
15	2174.					
16	2174.					